Whole Life Cycle Cost: a new approach

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Abstract: The last few years have seen significant improvements in the concepts, methods and general approach to calculating costs. ABC, Target Costing, Strategic Cost Management, functional analysis and costing are mobilising attention. Regardless of which of these approaches we consider, it is always from the point of view of one player whose intention is to benefit from increased knowledge of costs in order to achieve increased control over their value chain and profit margins. This self-centred vision is also present in the PLC (Product Life Cycle costing or cost of the product life cycle) concept, which is firmly anchored in product marketing. We are of the opinion that this type of economic calculation no longer fits our current industrial systems which is based on networks of partners contributing to R&D, manufacturing and services The network of organisations represents a growing complexity, necessitating even more complex costing and management methods than the recent innovations.

Keywords: product life cycle costing; value constellation; cost drivers.

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1. Introduction

In the actual globally changing business environment, companies are seeking new ways of providing additional value to customers and gain a competitive edge over their competitors. Product design and a clear focus on managing the entire product lifecycle have emerged as critical areas for investment. There is a shift in focus from production to design and middle and end of life. Past initiatives aimed solely at product cost, quality, or time-to-market are no longer sufficient to gain market advantage. The focus today is on innovation: products that differentiate themselves from others while also being affordable, reliable, and early to market (Schmid and John, 2004). Total management of the product lifecycle is critical to innovatively meet customer needs throughout its entire life cycle without driving up costs,

sacrificing quality, or delaying product delivery. The ability of industry to provide such holistic products and supporting services is currently limited by the information gap in the products life cycle (i.e. the flow of information between the design/production phase and middle and end of life phase of the products life cycle) (Brissaud, 1999, Edwin, 1995).
The last few years have seen significant improvements in the concepts, methods and general approach to calculating costs. Although the movement launched by the CAM-I (Consortium for Advanced Management-International) following the publication of the CMS (Cost Management System) outline document (Berliner and Brimson, 1998) remains the most well known (ABC for Activity Based Costing), it is not the only approach. It does have the advantage of a three-letter acronym but the Japanese idea, known as TC (Target Costing) (Ansari and Bell, 1997, Lorino, 1994) is also mobilising its share of attention, as is the functional analysis method initiated in the US (Yoshikawa et al., 1989). Finally, although certainly less well known, we must also make room for the work that can be grouped the SCM umbrella (Strategic Cost Management) (Shank and Govindarajan, 1993). If we were to attempt to summarise, we could try to place these three movements in separate categories, each fulfilling complementary needs in economic organisations. The goal of ABC-type methods is to improve management of current costs, while future costs are the focus of target-costing approaches. Beyond the costs still largely associated with products or services, there is room for a more overall and strategic approach to management: SCM. Regardless of which of these approaches we consider, it is always from the point of view of particular players whose intention is benefit from increased knowledge of costs in order to achieve increased control over their value chain and profit margins. This self-centred vision is also present in the PLC (Product Life Cycle costing or cost of the product life cycle) concept, which is firmly anchored in product marketing (Czyzewski and Hull, 1991). Our opinion is that this type of economic calculation no longer fits our current industrial systems. In an integrated design process, all the actors working during the product life (manufacturing, use, recycling, ...), have to share models of the product in order to give their specific constraints. In such an integrated methodology, the product is not built step-by-step in a linear process but is defined through an emerging process as a result of the progressive restrictions successively imposed by all the contributors (Bernard and Perry, 2003). Consequently, the promotion of integrated design may only be enabled by giving new tools for dialogue between participants. The nub is taking over from the "pole," the chain - whether it be the value or cost chain - has been superseded by the idea of system (Porter, 1996) or constellation (Norman and Ramirez, 1993). In this new universe being created before our very eyes, can one or other of the concepts referred to above claim to provide a solution to the necessary economic calculations aimed at achieving the most satisfactory possible use of resources? History has shown that each new type of organisation had to develop its economic management tools, incorporating elements from existing forms of organisation. In relation to existing forms of organisation, the network of organisations (which can themselves form a network) represents a growing complexity, necessitating even more complex costing and management methods than the recent innovations to which we have already referred. This is the challenge that the overall life cycle costing method seeks to confront. We will firstly specify the dimensions of the problem and then propose a theoretical base from which we will develop the preliminary methodology.

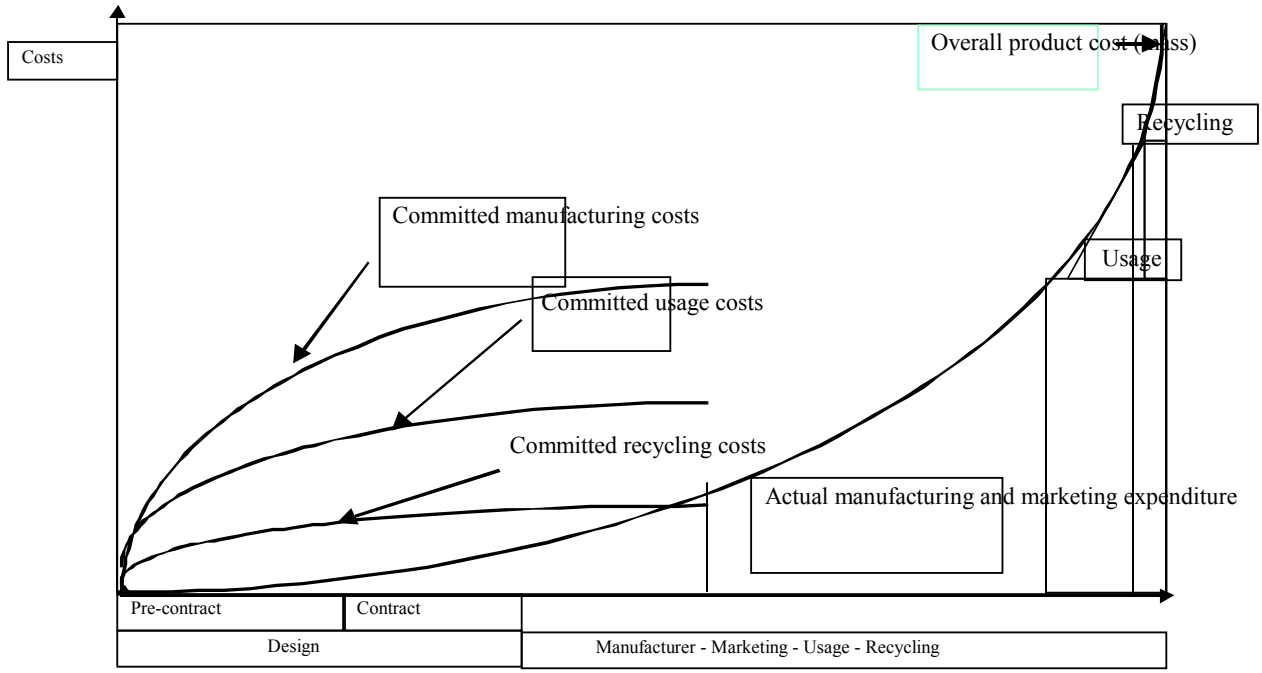
2. Changing perspectives

The last quarter of the 20th Century ushered in dramatic changes in cost calculation. Since its inception, cost calculation was used to improve our knowledge of production costs, however its application has gradually changed direction to focus on future product costs. This change of purpose is not the result of changes in costing techniques but rather a change in how we understand and model costs. Moving to a life cycle-based approach would appear to be an extension, over the longer term, of the movement that began in the 1970s. We will briefly outline the main points of this development and go on to illustrate how it naturally extends from the perspective of the company to that of the object, thus re-defining the time scale.
The Japanese idea of target costing (Monden, 1989), the American "design to cost" or the French concept of objective costs are all attempts at creating cost management devices with a view to controlling costs as far upstream as possible. Using the two, now familiar, curves of committed costs and actual expenditure

for which we are indebted to B.S. Blanchard (1978), popularised in CAM-I publications, business has developed various approaches to managing product life cycle costs as early as possible in this cycle.
What we can state, however, is that even when we refer to wide-ranging companies, almost all studies of target costing end at production costs. Although the production cost is indeed essential, it is not sufficient to provide an overall view of costs relative to products. The goal of the overall life cycle costing method is to replace the production life cycle with the concept of the whole life cycle of the product (Shields and Young, 1991). Figure 1 below represents the extension of hypotheses previously used to study only the production phase to cover a product's whole life cycle. There are two additional hypotheses.

Firstly, the usage costs of the product: although influenced by how the product is used by each individual user, these costs are nonetheless largely determined by choices made during the design stage. To illustrate this one need look no further than the case of fuel consumption by cars or consumption of electricity by household electrical appliances. Beyond direct consumption, we will also take into account the impact of design choices on the price tag or the type of insurance (remaining in the car sector for a moment). Secondly, recycling costs are also influenced in the main by the choices made at the design stage (choice of materials: plastic, steel, aluminium, glass, etc.) and at the assembly stage.

Figure 1: Overall Life cycle costs



It would of course be possible to add in other curves, such as the marketing costs, for example. For our purposes, we will assume that the company producing the goods has the ability to analyse the impact of design choices on marketing costs and that therefore these are incorporated into the production costs as part of the product delivery costs.
Logically speaking, if extending the time scale does not result in breaking away from the known target costing approaches, it does necessarily entail revising the analytic scope.

3. Changing the organisational perimeter

The introduction of suppliers into target cost analysis and SCM has already expanded the perspective of the company upstream. This time we want to extend the radius on all sides as evaluating the overall life cycle costs means incorporating into our analysis all the players involved throughout the whole product life cycle in one way or another. Design methodologies and organizations must be changed to cope with time-based competition. In this movement, traditional knowledge and expertise within technical domains (design, machining) are redefined. New actors arise (project managers, and more generally "interface actors") with new tools (CAD, PDM, ...). But, product design and manufacturing activity increases in complexity. This product development is shared among numerous actors and implies a great amount of

heterogeneous knowledge. Thus, the number of design criteria and variables has mushroomed. Companies now face a twofold difficulty with design projects: the need to deal with them as large-scale optimisation problems and the need to shorten the development cycle to a certain period. As a result, the difficulty is to make the best decisions possible with the information you have available and to be able to measure the impact of such a decision on the global project (choice of a material on the recycling ability of the product) (Yoshimura et al., 2003).

3.1 Changing perspectives: from the production plant to the company

The benchmark for cost calculations essentially remains production costs. You will also notice that future cost analyses are themselves also based on these same costs. This inheritance from the time when value was created during production through the transformation of raw materials has proved inveterate. Without purporting to have the last word on the subject, we can point to at least three types of reasons that contribute to perpetuating this practice, which is inconsistent with how modern companies operate.

Contrary to the recommendation that aims to use a specific type of cost per type of decision, we continue to use the same costing reference system, regardless of the type of decision. This is particularly striking in value engineering. In publications dating from the end of the 1990s, the recommended method for evaluating completed work in this context is the hourly rate charged. The result of this recommendation is to cancel out, using an irrelevant method of economic assessment, the operational efforts deployed because of the huge phenomena of subsidization that the method entails.

The second has to do with the technical nature of the product. This is broken down into a bill of materials and a bill of operations. These two elements constitute the natural bases for automated cost calculations in computerised production management systems. For the non-specialist: change the technical variables and turn around the black box (i.e. the costing software). The hypothesis of neutrality of the measurement tools specific the technical field is extended to cover economic methods.

Finally, the focus on production costs goes back to the idea of marginal cost. Developing a new product is the business of the production division and it is assumed that the impact on the other functions of the company is negligible. The underlying economic model is that production costs are variable according to volume whereas the other costs are fixed. Criticisms of the costing systems developed since the middle of the 1980s illustrate the extent to which this type of reasoning is contradicted by changes in the cost structure, re-transcribed in accounting documents as well as in the organisation itself.

While it seems necessary to go beyond the limits of the purely production function in a company, it is important not to interpret this extension of our analysis to the perimeter of the company as merely a change of costing reference system (for example, changing from production cost to total manufacturing cost). We should focus our research first of all on the impact of the new product on the rest of the company: change of suppliers (number and quality), change in human resources (qualification, number), change in communications, marketing, etc. The aim is to no longer consider anything as fixed. All elements in a company structure change. Therefore it is important when making strategic decisions, such as launching a new product or initiating innovation, to pinpoint the causes of changes throughout the whole structure. We then proceed to evaluate these effects, either in the form of a direct assessment (for example, recruit 3 technicians specialising in fluid mechanics) or through an evaluation based on long-term marginal costs through calculating the average cost of the process in question (a drop in the number of suppliers will be assessed using the average cost of suppliers management).

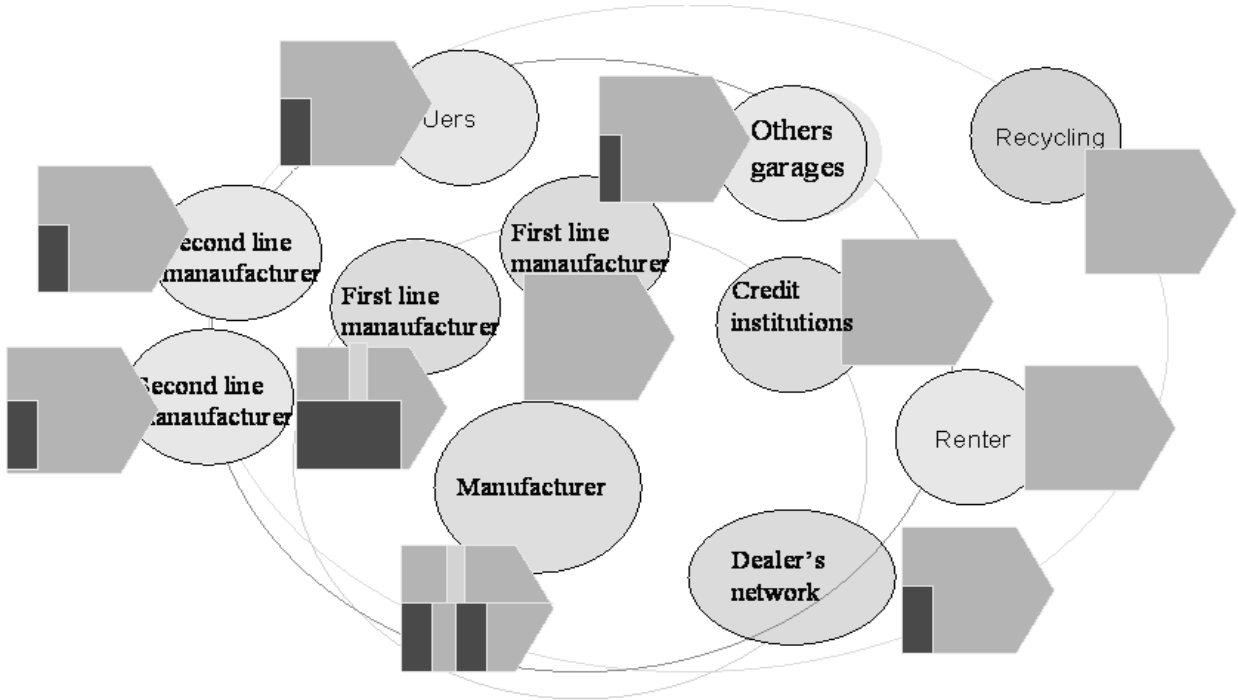
Our aim is to identify all the costs resulting from the innovation or the new product. This recommendation is not entirely a new one because as far back as the 1960s the US Defence Department proposed including in their costing of future products the cost of support activities and detailed cost management of those developments capable of yielding future gains. However the ratio of information provided for decision-making through this improvement in evaluation procedures in a company diminishes in relation to increasing outsourcing or, it only contributes partially to the level of satisfaction sought by the end user. In these increasingly frequent configurations, the analysis must be extended to cover the complete organisational structure, encompassing all of the activities involved in providing the service to the client.

3.2 Changing perspectives: from the company to the network of activities and partners

As we have said above, shifting focus from the production target cost to life cycle target cost assumes that we incorporate into the same analysis all of the activities and partners involved. The diagram which follows (Fig 2), borrowed from the automotive industry, is given as an illustration. However it is far from complete.

You will notice that this diagram includes the bulk of those partners that enable a private individual or a company to use the services of a car that meets their own value criteria while at the same time complying with all legal and regulatory requirements currently in force. However, a more detailed picture is necessary to understand the reality of the partners involved. It is in fact rare that the whole of a partner's business would be mobilised for one service. Only a few of its activities (operational and support) would be active. For the analysis, it is the level of activity that is relevant, for decision-making, it is the partnership level that is usually the most relevant. As our aim is limited to contributing to the analytical method, we will confine ourselves to referring in the main to activities.

Figure 2: Organisational perimeter



Returning to the terminology suggested by Norman (1993), we will refer to constellations. Within this set or constellation, there inevitably emerges "a leader that designs the service or product offered" (Kubota, 1999). The leader takes the central position. The company at the centre only fills the leadership slot for the specific item for which we are trying to estimate the cost and the value.
We could also use the image of a network, but we think that the network is only a reflection of the constellation at a given moment, for a project. The network is a result of regular partnerships or commercial relationships between the members of the constellation or, more accurately between their various spheres of activity. Without claiming to reconcile Porter and Ramirez, we are of the opinion that the constellation is the analytical framework and the network the result of the analysis. The question that arises is how do we determine which players, through their various activities, will experience the impact of the innovation or new product in their own situation? The response is a triple-pronged analysis. First of all map the constellation, then pinpoint the players and their relevant activities and finally, propose an impact assessment.
In concrete terms, these two first stages are partially interwoven. An outline of the constellation followed by a preliminary pinpointing of impacts could lead to hitherto unsuspected players that have never had any contact with the company at the centre. For example, the development of on-board computing in cars could lead one to include software distribution networks in the constellation. An iterative process is required to finalise the constellation and network of impacts

Within this constellation then, we have a similar task to perform to that currently being carried out in companies. That is to say, to pinpoint the impact of innovations or products on a set of players, whether it be direct or indirect and whether or not this impact is reflected in the accounts of the player that took the initiative for the operation. Naturally, we will find the impact on suppliers, a phenomenon that has already been studied by the Japanese in the context of analysing sub-contractor target costs (Monden, 1989, Cooper and Slagmulder, 1997). What is more innovative here are the impact assessment studies downstream. Returning to the three main cost categories influenced from the design stage, our research is aimed at all those concerned in one way or another by the use of the asset (insurance, finance, repair, re-sale, use, etc.) or recycling (collection, storage, dismantling, etc.).
Once we determine the impacts, we can assess them. The difficulties are considerable. It is no longer a question of amending an internal evaluation system but rather of connecting (and amending) currently disparate evaluation systems. In addition to the technical difficulties, there is a problem of policy as in reality the activities relate to companies or people with business relations. The level of transactions between them is based on a contact that usually has little to do with exchange of information, and when such sharing does exist, it is not exempt from criticism. The number of situations and technical solutions possible to assess impacts is as varied as the number of players involved.
Information on usage costs has already been compiled by consumer organisations and is regularly updated. It remains in this case to relate the various cost categories with the elements of the constellation to define the areas to be studied. Few of the people or companies involved are in direct contact with the initiator of the product/service, therefore very partial exchange of information should not cause undue conflict. Given the current state of legislation, recycling costs are still largely averaged out through taxation. In view of this, it is possible that we are now in a stage that is auspicious for exchange of information between partners. That leaves us with the most delicate point: the relation of the innovating company with its immediate partners upstream and downstream, first line suppliers and suppliers of after-sales services when these are not incorporated. The Japanese solution (as described in the literature available) is to formalise a win-win relationship and to explicitly specify the breakdown of joint gains. This is undoubtedly the way forward to break down the barriers to sharing information systems. In the large-scale consumer goods sector, the largest firms are essentially designers and assemblers of goods, this means that the discussion must deal with the essence of manufacturing costs and warranty usage costs. There is much at stake and it is understandable that partners take only measured steps forward. Nonetheless, it is in the hope of throwing some light on this problem that we outline the analytic framework below, relating cost and value. We hope to contribute to enriching the dialogue between partners, currently imprisoned in solely cost or, what amounts to the same thing, unit price schemas.

4. The necessary reconciliation of cost and value

The design activity is an activity where collaborative work and social dimension are of prime importance. By definition it is distributed among numerous actors and involves many objects of various natures (in opposition to a widely held opinion which states that design is a purely cognitive activity). The artefacts circulating within the organizations are traces of the product being designed and also traces of the compromises, which led to the actual technical solutions. But, most of the time, engineer focus on technical problems without taking into account the economical impact of the decision they take. Design for Manufacturing is a method, which tries to integrate the manufacturing, constrains (but also disassembly) in the early phases of product design (Whitney, 1988; Westkämper, 2003).
As a result, the integration of economical constrains at the same level than the technical lead to give engineer tools and levels to adjust their decision according to the global constrains, this becomes the Design to Cost approaches (Michaels and Wood, 1989).
Another approach has been popularized by Japanese firms and is known as target costing. In a target costing approach, cost and value are anticipated to secure profit margin. It was initiated in the production function. Switching from production target costing to overall target costing calls into question the foundation for the approach, which is the possibility of access to the value, expected by the end user. This method, which is a relatively simple concept, is based on analysing the exchange between a value and a cost and leaves the planned margin to the company. Expanding the analytic framework to the overall product life cycle makes it more difficult to anticipate the values and costs and increases the complexity

of the analysis because of the multiple client-supplier pairs to be incorporated. It is surely an illusion to think that we can obtain an analytical solution to this type of problem. Target costing, and the work of Lorino (1994) in particular have already shed light on this point. Lorino concluded his two articles by stressing that "target costing is a management approach … Ariadne's guiding thread to aid the company in creating its own organisational learning system". The discussion that follows seeks to contribute to defining an approach, which aims to draw the attention of decision-makers to the possibilities of improving overall management (over the whole life cycle) within the relevant constellation chosen as the framework.

4.1 Consistency of costing perimeter and the value management perimeter

Although complicated by the duration and different perceptions of risk and the value of time, adding a new time element to costing does not require any new developments. Present value methods plus perhaps options theory can provide the technical basis required. The choice of discount rate(s) is left up to the decision-makers.

However, adding a spatial element to costing does pose formidable problems if we accept our basic hypothesis (Fig 2; see example in the following box). That is to say, the impact of premature decisions on all the costs incurred by the various players within the constellation throughout the complete product life cycle.

> *Hypothesis 1: At this moment T0, we assess the production (A2) assembly (A3) and after-sales costs (A4) on the basis of the initial design work (A1,. The overall life cycle cost (CG1) is estimated by adding the costs generated by the four activities (Ai). Various changes are envisaged based on this initial estimate. For example, imagine reducing the costs at (A2) and (A4) as a result of these changes. If the costs are additive, then CG2 is equal to CG1 minus the improved costings at A2 and A4. However, in reality, the change that led to reduced costs at A2 actually causes an increase in (A3) costs and in order for the reduction of A4 costs to actually occur the costs at Ai, and most likely A2 and A3 must all increase. Thus, instead of CG2 being lower than CG1, it proves to be higher because of not adding in local costs.*

Improvements in instrumentation necessarily mean improving our approach to this problem. We think that the idea of cost drivers could be useful.

This idea was developed in the context of a company's internal management and again in the context of strategic cost analysis concentrating on its usefulness in a win-win policy in bilateral client-supplier type relations (Shank and Govindarajan, 1993). We are of the opinion that this idea must be at the core of our reflections on the overall life cycle cost of a product within the constellation presented above. The fact of conducting the analysis at the level of the constellation avoids the danger of creating opacity at each transaction.

The analysis is divided into two. First of all, we attempt to pinpoint the impact of design decisions on the whole constellation. If the product in question is complex, the reliability of the analytic work will increase by concentrating on its functions (Yoshikawa et al., 1989), each function resulting in a specific network of impacts within the constellation. Functional analysis is useful as it is directly related to the value expected by the customer. Furthermore, it is ongoing over the whole product life cycle. It is of natural advantage for our analysis.

It is important to be aware that the analysis must be an overall one and must not stop at the first point of non-impact. For example, the design choice to award a sub-assembly to a level 1 parts manufacturer may be of no particular consequence for the assembler's costs. It may however be very significant for recycling. The practical question arising is to define the range of our analysis (the adapted network), with the knowledge that it is impossible to inventory and later evaluate all the effects. A simple coding system, such as strong, average, weak, or, initially limited to strong-weak, will assist us in determining the analytic scope. We would stress that the impacts we are examining have an effect on all the players and all the activities or processes they are involved in. In particular, it is essential to examine support

activities as well as operational activities, tangible and intangible investments, as well as direct and indirect costs (to use accounting language) (McGroarty and Horngren, 1993).
Impact assessment sheets are used for the analysis (Fig 3). For each member of the constellation, the sheets highlight the decisions and their consequences in terms of input, output and capacity. Inputs and outputs enable us to pinpoint where the impact of the decision is felt. Each output is in turn the subject of a new impact assessment sheet along the same lines.

Characterising and tracing all of these impacts in the constellation provides the processes to analyse (Fig 4). Each process is a path, within the network of impacts, within the constellation. It seems to us important to determine the whole process, that is to say composed of all the impacts, and to include what we may consider as weak and not for assessment. In fact, when changes do occur, weak impacts can prove to be strong and vice versa. It is therefore vital to always have a proper analytic base. Naturally this does not exclude the possibility of new impacts appearing.

Figure 3: Impact assessment

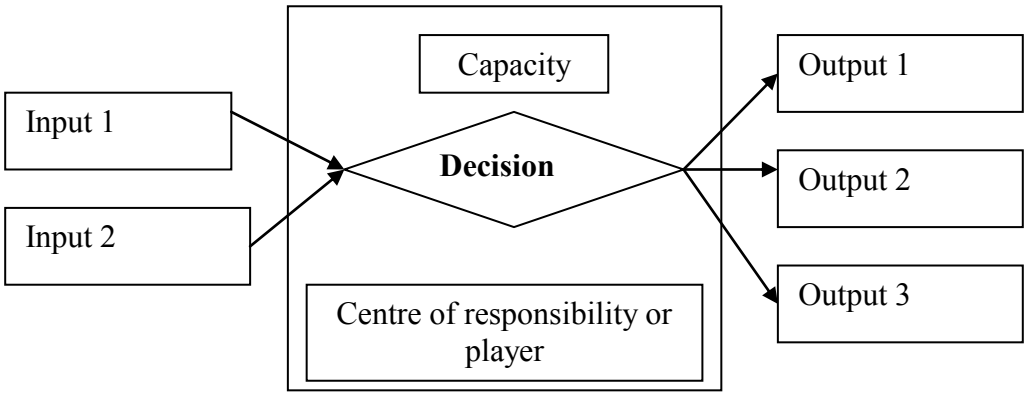
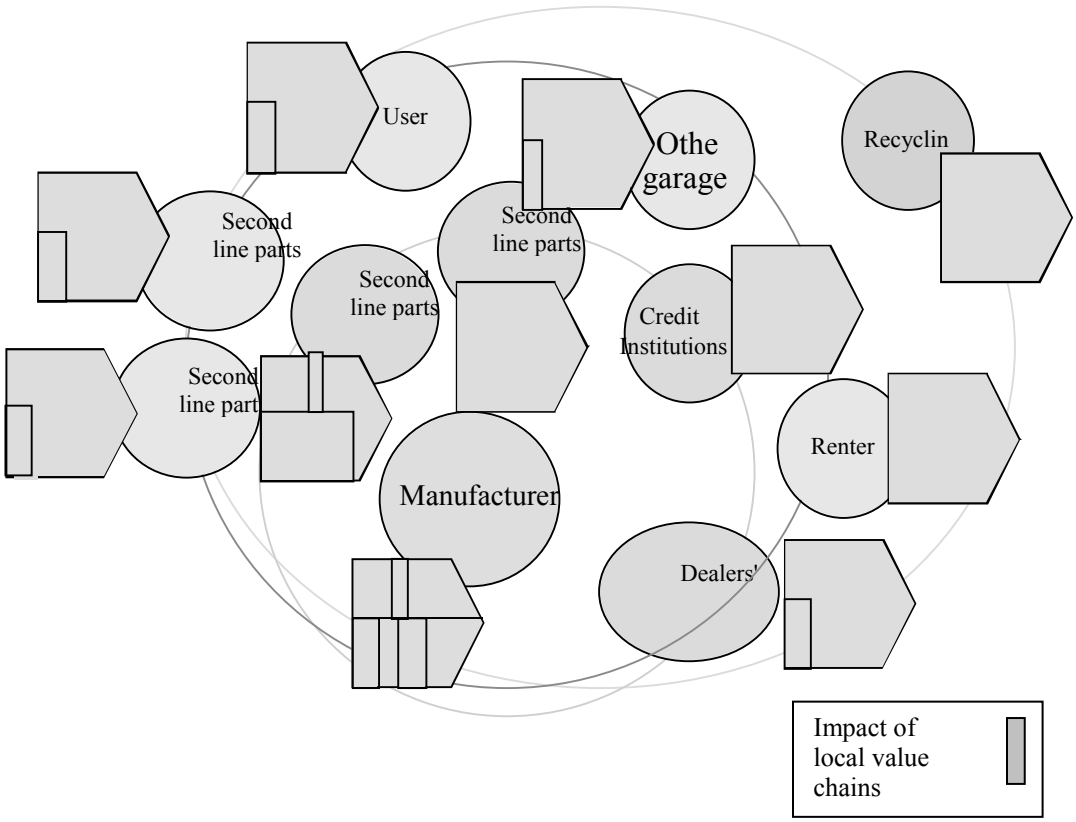


Figure 4: Impacts network



Advancing from pinpointing impacts to assessing them is a formidable challenge. It is most unlikely that it will be easy to calculate local costs. Furthermore, as we have already shown, local costs are not

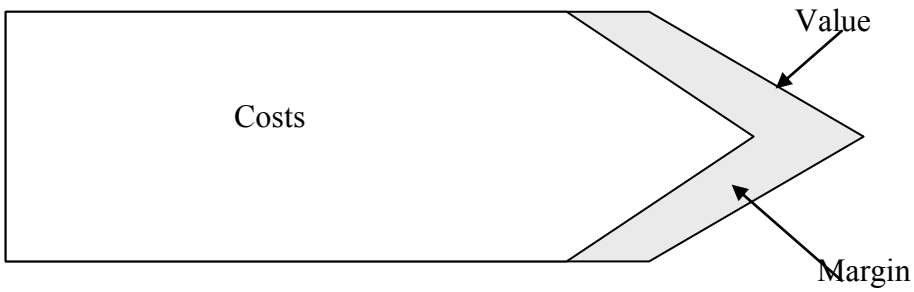
additives inasmuch as they are interdependent. Therefore it is necessary to model, at least roughly, the interrelations between the costs incurred by the various players involved in each process. To illustrate this problem, let us take the classic example of the purchase of raw materials or parts at a low unit price but of a mediocre quality. Even if the decision to purchase better-quality parts at a higher price does not alter the overall purchase price, the fact that the better materials require less work increases the production capacity of the next stage. There is no real gain unless the capacity is used for additional production. However, we could say that there is value creation inasmuch as this increases the reactivity potential of the activity or company in question. You will see from this example that we cannot separate an evaluation of overall life cycle cost from value.
The fact of placing a major technical part in an engine so that it is accessible has no influence on the direct relation between the manufacturer and the user at the time of purchase. However, the maintenance cost is reduced because access to the part is easy. The user can either repair the problem himself or, the repairer can do the job faster. Dismantling for recycling is also easier.
This example shows that our traditional idea about the customer is no longer relevant. You can list at least two or three customers for one action. If there are three customers, it means that there are also three value-creation mechanisms. Can we reduce these three processes to one sole transaction between a manufacturer and a client of a good or, is it possible to imagine something else? Can we envisage three transactions corresponding to the three value-creation mechanisms? It seems that it is less a question of juxtaposing a value chain in the "Porter" sense of the word to the overall life cycle cost, than a constellation of values, which is co-created by the players' actions at each transaction. We cannot define where this constellation begins or ends (Ramirez, 1999). If there now enters a completely new and unexpected member to the constellation, for example, re-training workshops working on restoring old scrapped electrical appliances, we see that value creation is not a finite process. At any point in the product life cycle, the joint action of at least two players can add a grain of value to the whole.

4.2 Cost and value for the partners

The vision of value creation implicit in the iconography used by Porter is not very far from the classical view of value. Costs accumulate gradually as the product progresses through the various functions of the company (the cost arrow in Figure 6 is going in the same direction as the price arrow). The value recognised by the customer is confused with receipts (the price arrow in Fig. 5) as its comparison with cost gives the margin. in this diagram, it is important to underline that, on the one hand value and costs are going in the same direction, which implies that customers naturally recognise that value has been created by the expenditure committed by the company. On the other hand the value perceived by the customer is totally translated into the exchange value, i.e. the price. This view leads in essence to price-reducing behaviour inasmuch as it does not invite a cost-value dialogue (Parolini, 1999). The fact the two elements are found in the same diagram going in the same direction leads to different scenarios, according to whether you believe that the price is fixed or not by the market: it either restricts costs or increases the cost margin to obtain the price

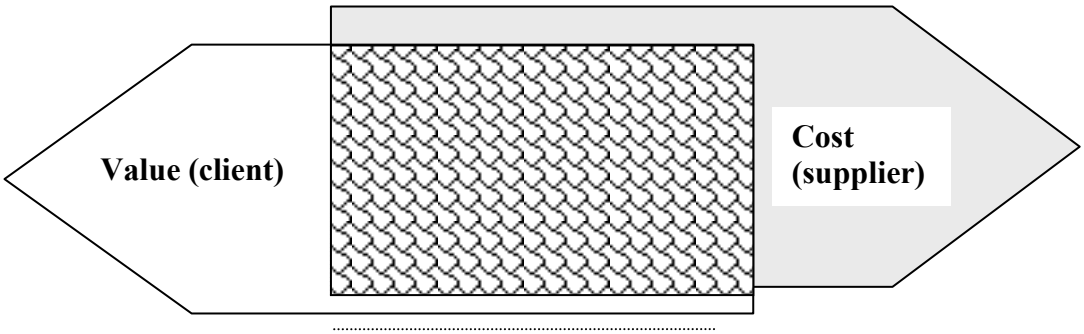
In the alternative vision proposed here (Fig. 6), cost and value are oriented in different directions. The costs reflect consumption of resources by the company, the value received by the customer in the form of an expectation of a set of attributes is more or less perfectly consonant with what the company has to offer. Some costs were incurred in vain, others, on the contrary, produce attributes, the perceived value of which are considerably superior to the resources used to produce them. It is the result of these various comparisons that is reflected in the price. However, price here is neither the cost nor the value, but the result of juxtaposing the value as perceived by the customer with the customer value forecasted by the company, based on its knowledge of costs and, naturally, its power in business negotiations.
It goes without saying that the more the dialogue between the members of the constellation is facilitated and the more we can postulate the efficiency of the constellation in the value-production process, the more costs and perceived value will go hand-in-hand. In Figure 6 above, many resources have been used in vain (shaded area) and some customer expectations have not been satisfied (white). Only the grid section of the diagram corresponds to an efficient relation.

Figure 5: Porter's value chain



Whether we put ourselves in the customer's or the supplier's shoes, two questions arise: what are the bases for negotiation (value attributes and cost inductors) and what are the volumes concerned? In an efficient universe, suppliers produce exactly what customers want and in the required quantities, based on perceived value. To efficiently allocate resources in the constellation, the supplier must determine its costs on exactly the same basis as that used by the client in attributing value (Dean, 1999, Mévellec, 1998, Mévellec et Lebas, 1998). In other words, the supplier's cost drivers must be identical to the customer's value attributes. This is one of the rules of management that holds for all processes.

Figure 6: Alternative vision of the cost and value relation



The practical implementation of a true win-win approach assumes a sweeping reform of the cost systems to make possible the only useful dialogue, i.e. the cost-value dialogue. Does such a reform, if it is possible, remove all usefulness from the negotiation? Not at all, because both the bases and perception of value attributes are tainted by a large degree of uncertainty, especially at the beginning of the life cycle. What the negotiation can produce is a more rapid convergence between value representations and a more rapid adaptation of the constellation's activities towards conditions of efficiency.

5. Provisional conclusion

Reflecting the developments in other areas of the life of organisations, such as quality and timeframe management, the economic movement currently underway cannot be reduced to its instrumental aspect. The toolbox, even new-and-improved to include innovations with catchy acronyms, can only act as a support for a renewed organisational analysis, opening the organisation to multiple and changing partners and asking the only worthwhile question: which value production are we involved in and in what conditions? To move forward in that direction engineer must understand how cost systems are built, what are the cost and value drivers. What is in question is not manufacturing costs but global lifecycle cost. The challenge is to design new costing approaches and integrate their usage in the early phases of product design development. New lifecycle costs models have to be created validated by real case study comparison and integrated in decision-making toolbox for engineers and managers. As the future costs and value are generated trough a constellation of activities the PLM methodology should help each partner to understand and progressively to measure the impact of decision making on all the aspects of the product lifecycle.

Engineers already know to communicate on the physical side of the innovations, they have to learn to communicate on it social side by a closed cooperation with cost managers and marketing experts
Beyond seeking to take costs into account as early as possible in the product life cycle, what we are really engaged in here is a questioning of the management methods used by organisations and their place on the economic stage. The fact of putting the cost-value pair under the microscope in processes as diverse as innovation, supply of parts or functions, customer service or our relationship with the environment through recycling, puts us squarely up against the question of value creation in our
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